Endoscopic Anatomy of the Middle Ethmoidal Artery: A Cadaver Study
Is it a Fact or Myth?

By
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Why Important???

Knowledge of anatomy of ethmoidal arteries is crucial before:

- Epistaxis.
- Orbital surgeries and decompression.
- Extended endoscopic skull base surgery (i.e. excision of ethesioneuroplastoma)
Ethmoidal arteries are described as anterior and posterior; however, others have demonstrated the presence of a middle ethmoidal artery, also called accessory ethmoidal artery. These previous studies observed the foramina on the medial orbital wall so as to indirectly infer the presence of the middle ethmoidal artery (i.e. neurovascular bundle).
### Number of middle ethmoidal foramina

<table>
<thead>
<tr>
<th>Author</th>
<th>Year</th>
<th>Specimen</th>
<th>1 MEF (middle ethmoidal foramina)</th>
<th>&gt;(middle ethmoidal foramina) 1 MEF*</th>
<th>Both sides</th>
<th>Total MEF*</th>
<th>Anatomical variation (1, 3 or 4)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Del <em>1</em></td>
<td>1952</td>
<td>655 dry skulls</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>49.4%</td>
</tr>
<tr>
<td>Rontal et al. <em>2</em></td>
<td>1979</td>
<td>48 orbits (24 dry skulls)</td>
<td>12(25.0%)</td>
<td>0</td>
<td>12(25.0%)</td>
<td></td>
<td></td>
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<tr>
<td>Isaacson et al. <em>3</em></td>
<td>2003</td>
<td>40 orbits (20 dry skulls)</td>
<td>6(15%)</td>
<td>0</td>
<td></td>
<td>6(15%)</td>
<td></td>
</tr>
<tr>
<td>Cheng et al. <em>4</em></td>
<td>2008</td>
<td>193 orbits (97 dry skulls)</td>
<td>77(39.9%)</td>
<td>2</td>
<td></td>
<td>79(40.9%)</td>
<td></td>
</tr>
<tr>
<td>Takahashi et al. <em>5</em></td>
<td>2011</td>
<td>54 orbits (27 cadavers)</td>
<td>17(31.5%)</td>
<td>1</td>
<td>7(13.0%)</td>
<td>18(33.3%)</td>
<td></td>
</tr>
<tr>
<td>Abed et al. <em>6</em></td>
<td>2012</td>
<td>47 orbits (24 cadavers)</td>
<td>17(36.2%)</td>
<td>3</td>
<td></td>
<td>20(42.6%)</td>
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MATERIALS AND METHODS

- We dissected 22 adult specimens (44 sides) at the Anatomy Laboratory Toward Visuospatial Surgical Innovations in Otolaryngology and Neurosurgery (ALT-VISION), at The Ohio State University.
- Rod-lens Hopkins endoscopes (Karl Storz Endoscopy; Tuttlingen, Germany) of 4 mm in diameter and 18 cm in length with $0^\circ$ and $45^\circ$ lenses were used during the dissections, coupled to a high-definition video camera and monitor.

STEPS OF DISSECTION

- unicenectomy
- Ethmoidectomies and Frontal sinusotomy
- Exposure of fovea ethmoidalis and bony canals of ethmoidal arteries
- Removal of lamina paprycea to identify the arteries themselves
- Removal of bone covering ethmoidal canals using a high speed drill.
RESULTS

- A total of 14 middle ethmoidal arteries were identified among 22 specimens (44 sides), for an incidence of 31.8%. A middle ethmoidal artery was more common on the right side (10/22; 45%) than on the left (4/22; 18%). Bilateral middle ethmoidal arteries were found in 3 specimens (14%).

INCIDENCE OF MIDDLE ETHMOIDAL ARTERY

<table>
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<tr>
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<th>Left side</th>
<th>Right side</th>
<th>Both sides</th>
<th>Total</th>
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<tbody>
<tr>
<td>Number</td>
<td>4/22</td>
<td>10/22</td>
<td>3/22</td>
<td>14/44</td>
</tr>
<tr>
<td>Incidence</td>
<td>18%</td>
<td>45%</td>
<td>14%</td>
<td>31.8%</td>
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</table>
Type 1 Middle ethmoidal artery at the right skull base (after frontal sinusotomy and ethmoidectomy). The anterior skull base and lamina papyracea are intact. AEA: anterior ethmoidal artery; MEA: middle ethmoidal artery; PEA: posterior ethmoidal artery.

Features of Middle Ethmoidal Artery

- The bony canal of middle ethmoidal artery seems thicker than that of the anterior ethmoidal artery; therefore, it is difficult to identify the artery through the bone;
- The middle ethmoidal artery seems smaller and thinner than the anterior ethmoidal artery.
we found two types of middle ethmoidal arteries:

- Type 1 is a middle ethmoidal artery that crosses the fovea ethmoidalis within a bony canal that forms a bony ridge on the anterior skull base, and is identifiable by endonasal endoscopy.

- Type 2 is a middle ethmoidal artery that crosses the fovea ethmoidalis within a bony canal that does not form a bony ridge on the anterior skull base, and; therefore, we must remove the lamina papyracea to identify artery.

Exposure of the middle ethmoidal artery after removing the lamina papyracea and drilling off the bony canals. AEA: anterior ethmoidal artery; MEA: middle ethmoidal artery; PEA: posterior ethmoidal artery.
Endoscopic view of the right anterior skull base, showing a Type 1 middle ethmoidal artery. AEA: anterior ethmoidal artery; MEA: middle ethmoidal artery; PEA: posterior ethmoidal artery.

Endoscopic view of the left anterior skull base, showing a Type 1 middle ethmoidal artery. AEA: anterior ethmoidal artery; MEA: middle ethmoidal artery; PEA: posterior ethmoidal artery.
Type 2 middle ethmoidal artery (right side). The middle ethmoidal artery is smaller than the anterior. AEA: anterior ethmoidal artery; MEA: middle ethmoidal artery; PEA: posterior ethmoidal artery.

Close-up view of middle ethmoidal artery observed clearly. MEA: middle ethmoidal artery; PEA: posterior ethmoidal artery.
**ETHMOIDAL ARTERY BEFORE AND AFTER REMOVING THE LAMINA PAPYRACEA**

<table>
<thead>
<tr>
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<th>Left side</th>
<th>Right side</th>
<th>Both sides</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nasal*</td>
<td>3</td>
<td>6</td>
<td>3</td>
<td>9</td>
</tr>
<tr>
<td>Orbital*</td>
<td>4</td>
<td>10</td>
<td>3</td>
<td>14</td>
</tr>
<tr>
<td>Incidence*</td>
<td>75%</td>
<td>60%</td>
<td>100%</td>
<td>64.3%</td>
</tr>
</tbody>
</table>

Nasal*: observed from nasal side before removing lamina papyracea. 
Orbital*: observed from orbital side after removing lamina papyracea. 
Incidence*: Combined nasal* + orbital*

**LOCATION OF MIDDLE ETHMOIDAL ARTERY**

Schematic diagram of the left anterior skull base. Point A and P in this figure represent where the anterior and posterior ethmoidal arteries enter the roof of the ethmoid labyrinth, respectively. Point M is the midpoint between point A and B, and point M’ is the midpoint between point M and P.
LOCATION OF MIDDLE ETHMOIDAL ARTERY

- In this study, 12 (85.7%) middle ethmoidal arteries were found between point M and M' and the remaining 2 cases arteries (14.3%) were found between point M' and P, relatively closer to point P.

CONCLUSION

This is the first study that uses the approach of endoscopic endonasal to observe the anatomical features of the middle ethmoidal artery. Findings of this research have clinical relevance and significance during surgeries of medial orbital wall, intractable epistaxis, and anterior skull base tumors, as well as the traditional endoscopic endonasal surgeries.
REFERENCES


THANK YOU

If you want the original paper or have any comments: please email me on: ahmedyouseef2002@yahoo.com